


# Inquiring Minds Want to Know!





God surprise us with your presence  
and grant us the grace to experience  
the world with a sense of wonder and awe.

***Lord we ask you for the eyes of a child:***

*To find joy in simple things*

*To pay attention to the whispers beneath the clamor*

*To delight in daily discoveries*

*To see the extraordinary in the ordinary*

*To peer deeply into the eyes of someone who cares*

*To see things from a different point of view*

*To feel the thrill of the quest*

*To explore whatever is right in front of us*

*To learn something new and savor that moment*

*To celebrate the miracle of each moment.*

*Lord refresh my sense of curiosity*

*Open my eyes to your marvels and*

*Connect me once again with your sacred surprises.*

*Amen*

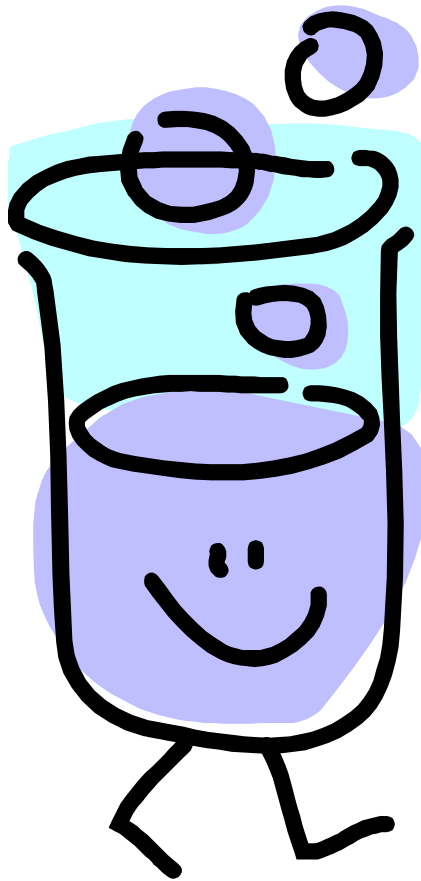


A word cloud featuring various terms related to science education. The words are arranged in a non-uniform, overlapping manner. The colors range from dark red to orange. The words include:

- believe
- connections
- age
- self-discovery
- involve
- hands-on
- practical
- science
- cross-curricular
- engaging
- exploring
- interactive
- make
- investigation
- relevant
- discovery
- related
- interesting
- fun
- applied
- based
- memorable
- real
- user-friendly
- text
- appropriate
- meaningful
- inquiry
- journey
- world

# Hands On! Minds On!

- Demo – Egg in Cup



# Learning Goals

**By the end of this session you will:**

- be able to demonstrate an understanding of what inquiry based learning looks like in a science class
- become familiar with the Smarter Science framework
- plan for inquiry in your classroom



# Agenda for the Session

- MINDS ON

- Welcome and Prayer
- Hands On! Minds On! Demo
- Learning Goals
- What's the Big Idea? / Inquiry Question
- Activating Prior knowledge
  - Is this Inquiry? Graffiti activity
- What is Inquiry?



- ACTION

- Exploring Inquiry-based Learning in Science
- Stops along the inquiry continuum
- The Smarter Science Framework

- CONSOLIDATION

- The Smarter Science Framework: interconnected Literacy, Numeracy, and Science
- Applying the Smarter Science Framework to a different inquiry
- Revisiting “What is Inquiry?”

# The Big Idea



## Inquiry Based Learning

***“Tell me and I forget,  
Show me and I remember,  
Involve me and I understand”***



## Our Inquiry Question:

What can inquiry-based learning  
look like in science?





# Is this Inquiry?

## Graffiti Activity



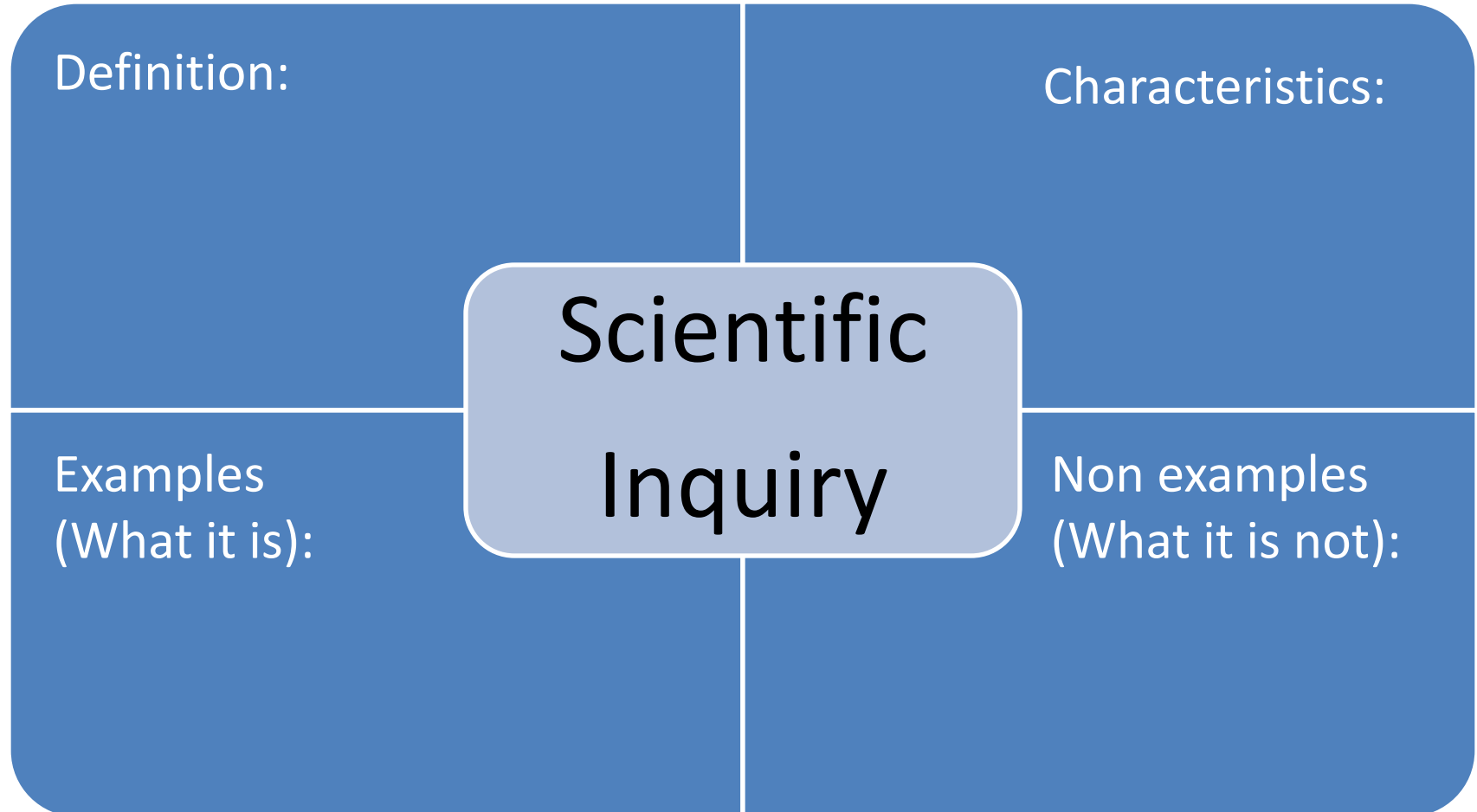
- Visit each of the 4 charts posted.
- Read and discuss the student sample or teacher assignment provided.
- Discuss whether this sample/assignment is “inquiry based” / an example of “inquiry”.
- Record your group’s thoughts and ideas on the chart paper. Respond to or add onto other groups’ ideas.

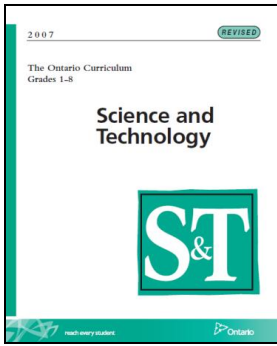


# What is Inquiry?

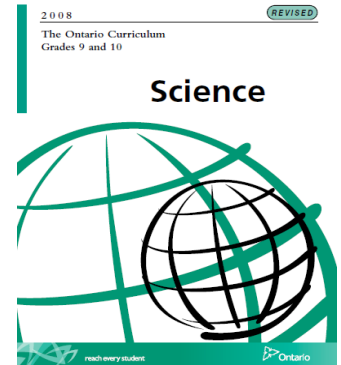


## Frayer Model





# Curriculum connections to Inquiry

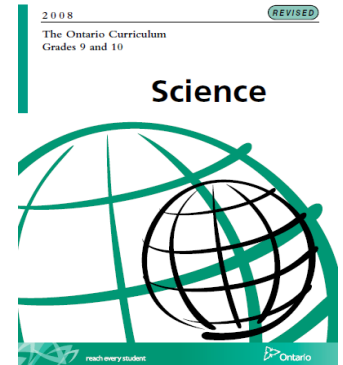


## The Goals of the Science (and Technology) Program

- 1. To relate science and technology to society and the environment
- 2. to develop the skills, strategies, and habits of mind required for scientific inquiry/investigation (and technological problem solving)
- 3. to understand the basic concepts of science (and technology)



# Curriculum connections to Inquiry

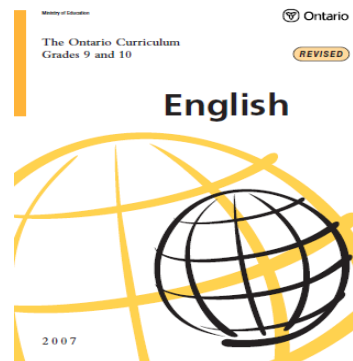
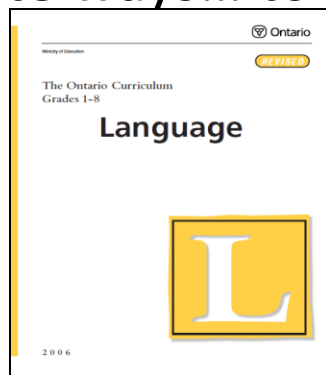


“An inquiry approach, with emphasis on learning through concrete, hands-on experiences, best enables students to develop the conceptual foundation they need.”

- Pg. 29 Science, Gr. 1-8
- Pg. 30 Science, Gr. 9-10
- Pg. 32, Science, Gr. 11-12

# Curriculum connections to Inquiry

- “Inquiry is at the heart of learning in all subject areas. Students are encouraged to develop their ability to ask questions and to explore a variety of possible answers to those questions. They acquire the skills to locate relevant information from a variety of sources, such as books, newspapers, dictionaries, encyclopaedias, interviews, videos, and the Internet. The questioning they practised in the early grades becomes more sophisticated as they learn that all sources of information have a particular point of view and that the recipient of the information has a responsibility to evaluate it, determine its validity and relevance, and use it in appropriate ways... to become an independent, lifelong learner.



- Language, Gr. 1 – 8 , pg. 29
- English, Gr. 9 – 10, pg. 34



# Action:

## 4 categories of inquiry



- Demo
- Activity or “Cookbook” Lab
- Teacher-initiated
- Student-initiated

# The Inquiry Grid

	Demonstration	Activity or “cookbook lab”	Teacher- Initiated Inquiry	Student- Initiated Inquiry
Posing the Question	teacher	teacher	teacher	student
Planning the Procedure	teacher	teacher	student	student
Formulating the Results	teacher	student	student	student

Llewellyn's *Teaching High School Science Through Inquiry* pp. 66-76

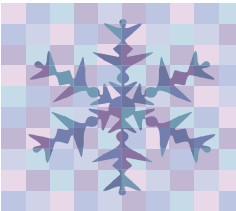
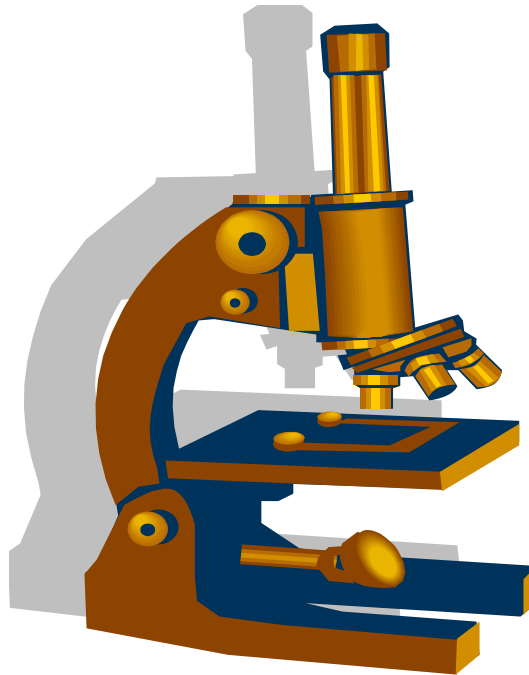
# Conversation Partners





# Tweaking a “Cookbook” lab

- Preparing a wet mount





## Wiki link



<http://www.dpcdsb-ssc.wikispaces.com/>

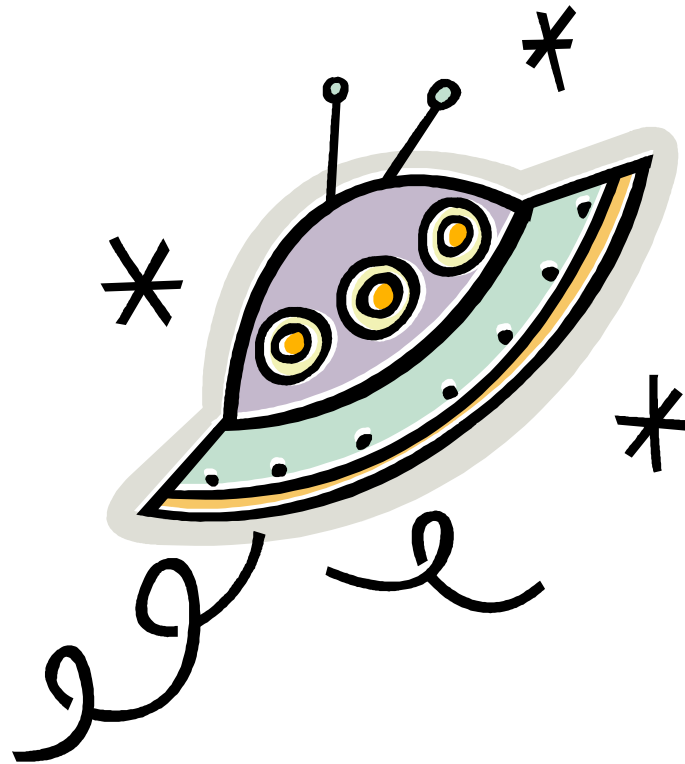
# New Approaches to Traditional Labs

- Revise the:
  - Question Section
  - Materials Section
  - Procedure Section
- Take Away the Data Table or Chart
- Do the Lab First

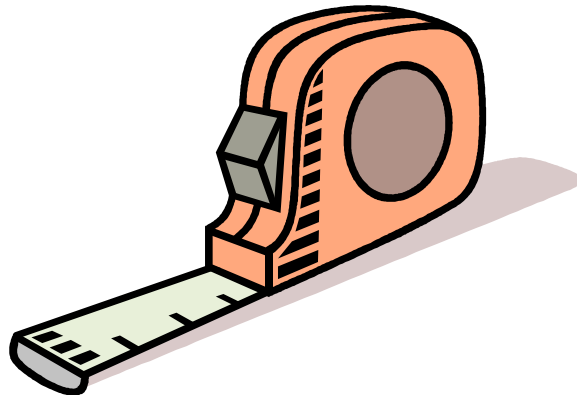
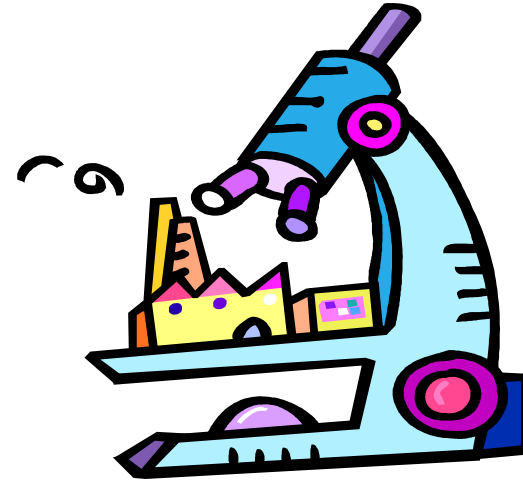


Llewellyn,  
Teaching High School Science Through Inquiry, pg. 91-95  
Inquire Within, pg. 76 - 78

# Demo – Let's make a human circle!



# Making Good Observations



# How many drops of water can fit on a penny?



# Student Initiated Inquiry



Using the Smarter Science Framework

# smarter science éducation sciences



Adapted from research by Troubridge, Ryboe and Powell 2000

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SEARCH

### What is Smarter Science?



Smarter Science is an open-source, engaging framework for teaching and learning science in grades 1-12 and for developing the skills of inquiry, creativity and innovation in a meaningful and engaging manner.

### Resources to work fast



If you are looking for lesson plans, ideas for modifying your present lessons or links to inquiry-based resources, browse the menu or use the 'search' box (upper right)

### Purchasing Smarter Science materials



Purchase posters and materials we use for teaching and demonstrations. We make it a point to use inexpensive materials and our posters are available for purchase on a cost-recovery basis. [Click here](#)

## Smarter Science to Kick Off Science Fair Campaign



November 16, 2010 | [SHARE](#)

Smarter Science is on the move! Today we will be in North Bay, at Nipissing University, to kick off a campaign to get more students involved in science fairs. Watch the keynote live at: [mms://streamer.nipissingu.ca/invent](http://mms://streamer.nipissingu.ca/invent) at 7pm.

Mike Newnham, Program Director of Smarter Science, will be giving a keynote speech called "Invent the..."

Tags: [Story](#)

### Blog Posts

#### SCCAO

November 10, 2010 by newnham

Assessment and Evaluation with Damian Cooper was the topic of the day at the SCCAO (Science Coordinators and Consultants Association of Ontario)...

**Eureka! Hands-on Minds-on Science -Current Electricity -- The Electrical Circuit**

### Professional Development

#### Declining Interest Sparks Analysis

November 3, 2010 by newnham

from the North Bay Nugget Organizers for the North Bay Regional Science Fair are planting seeds for renewed interest in the annual spring contest...

#### Inquiry By The Bay-Reflections

October 22, 2010 by newnham

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# Baggy Science



# Assessing Inquiry-based Learning

- Damian Cooper's Rubric & Self-Assessment Checklist

# Demos - Electricity





# Consolidation:

## Card Sorter Activity

- Sort cards in envelope into 3 groupings:
  - Numeracy skills
  - Literacy skills
  - Both numeracy & Literacy skills



## Observing

Using the 5 senses to find out about objects and events, their characteristics, properties, differences, similarities and changes. Observation can be made directly with the senses or indirectly through the use of simple or complex instruments.

## Questioning

A strategy to make meaning or wonder about uncertainties.

## Searching

Locating and using several sources, developing self-reliance in acquiring library and internet skills.

## Interviewing

Asking, interviewing, and corresponding to gain primary information.

## Inferring

Using logic to draw conclusions from the results of investigating/problem-solving.

## Predicting

Predictions are not random guesses but speculations of what may occur in the future based on prior knowledge, observations, and reasoning.

## Hypothesizing

Making educated guesses or predictions based on evidence that must be tested through experimentation to establish credibility. Or, hypotheses are suggested explanations of phenomena that guides investigations from which further predictions can be made. Hypotheses generally follow a "If-then..." statement format.

## Modeling

Constructing physical/concrete or abstract representations of ideas, objects or events to clarify explanations or demonstrate relationships. Models are used to reinforce concepts, demonstrate learning, and/or illustrate phenomena which cannot be directly observed.

## Investigating

Gathering background information, formulating problems/hypotheses.

## Using Instruments

Knowing the instrument's parts, how it works, how to adjust it, its proper use for a given task, its limitations: knowing how to store it and transport it safely.

## Calibrating

Checking, adjusting or determining by comparison with a standard (e.g., calibrating a thermometer, balance, timer or other instrument).

## Measuring

Assigning numbers to observations, e.g., metric units, time, student-generated units, using appropriate measuring devices and techniques.

## Recording

Noting, documenting, tabulating, charting, working systematically, working regularly.

## Planning

Systematically, working regularly organizing for future, seeing possible results.

## Designing

The overall plan or strategy by which hypotheses/research questions technological problems are answered (with or without innovation).

## Gathering Data

Collecting evidence through measurements, facts, figures, pieces of information, statistics, either historical or modern, data calculation, experimentation, surveys, etc.

## Demonstrating

Setting up apparatus, making it work, describing parts and functions, illustrating scientific principles.

## Constructing

Putting together component parts; to build or erect.

## Inventing

Designing something useful, for the first time, through the use of the imagination, ingenious thinking and/or experimentation.

## Experimenting

Carrying out a designed investigation to test a hypothesis or answer a question.

## Comparing

Looking for similarities.

## Contrasting

Looking for differences.

## Classifying

Putting things into groups and subgroups, identifying categories, deciding between alternatives.

## Outlining

Employing major headings and subheadings, using sequential, logical organization.

## Graphing

Visually representing data.

## Analyzing

Seeing implications and relationships, discerning causes and effects, locating new problems.

## Evaluating

Recognizing good and poor features; judging and assessing.

## Reviewing

Picking out important items, memorizing, associating.

## Discussing

Engaging in interactive oral, written or any other appropriate form of communication.

## Explaining

Clearly describing, clarifying main points and focusing on the "why" and/or "how" of the issue, concept or idea.

## Reporting

Organizing and presenting information in a written or oral format.

## Writing

Conveying information (e.g., questions, observations, experimental report) by graphical means.

## Reflecting

The activity of either an individual or group that involves analyzing, judging the importance of, and making connections to the learning experience.

## Teaching

Making meaning of concepts or processes, by organizing them into key facts and ideas, and clearly conveying them to others.

BEGINNING

EXPLORING

EMERGING

COMPETENT

PROFICIENT

ENGAGE

EXPLORE

EXPLAIN

EXTEND





# Predicting, Inferring and Hypothesizing Oh my!



What 's the difference?

(insert comic)



Predict what will happen next...



(insert comic)

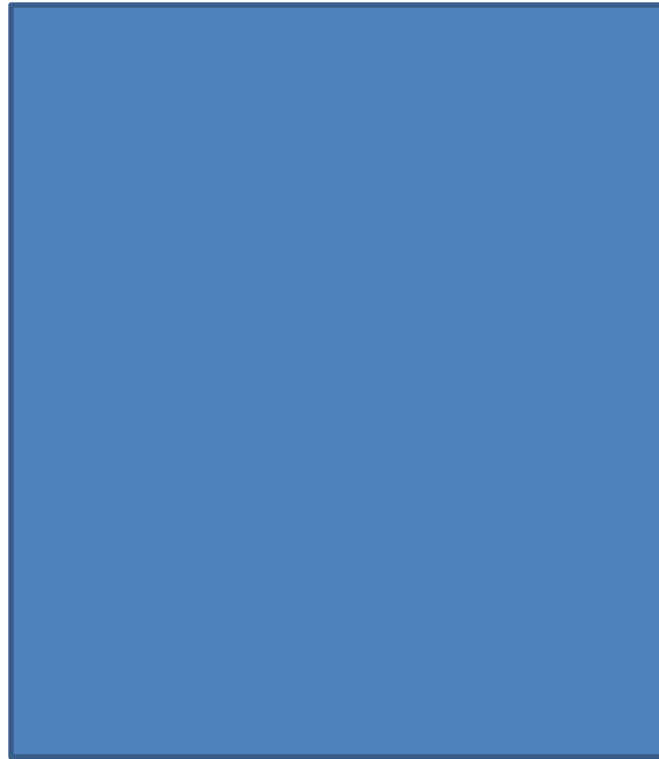


Infer why this is so...

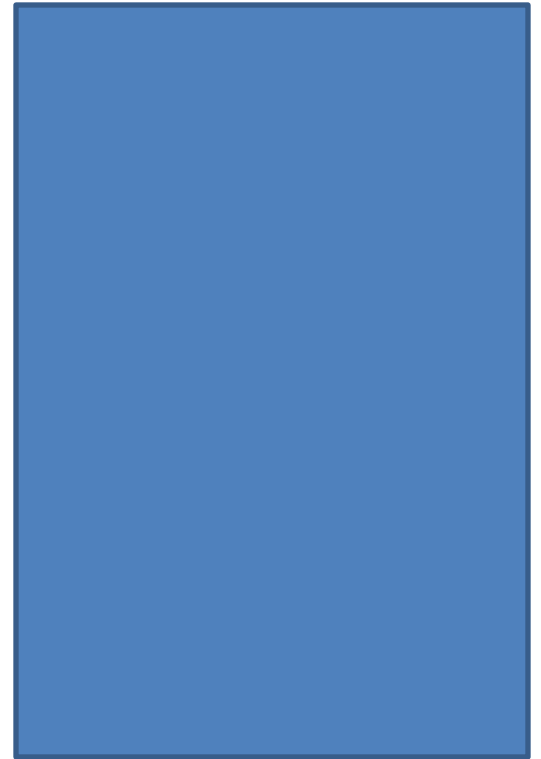
(insert comic)



If...

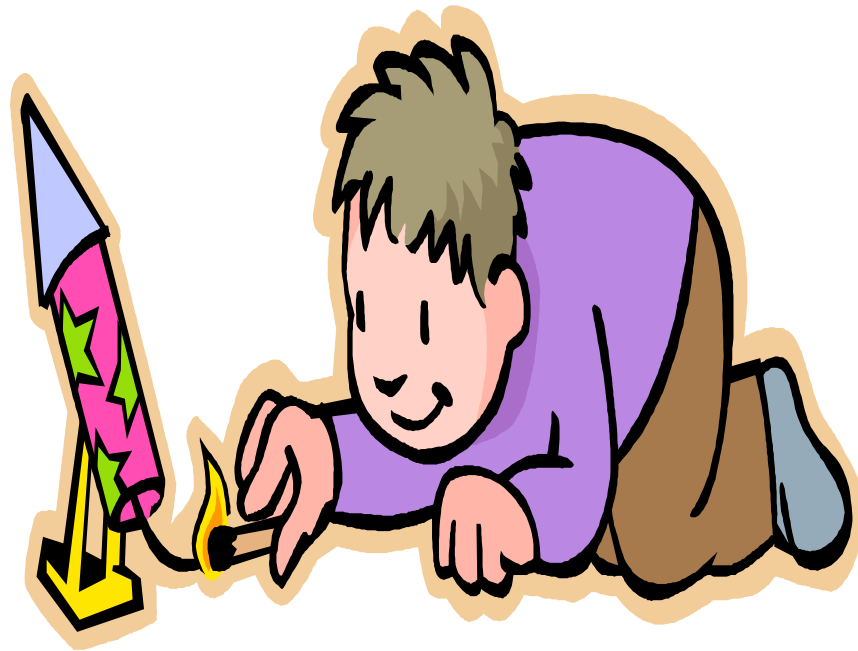


then...



investigate...

# Alka seltzer rockets

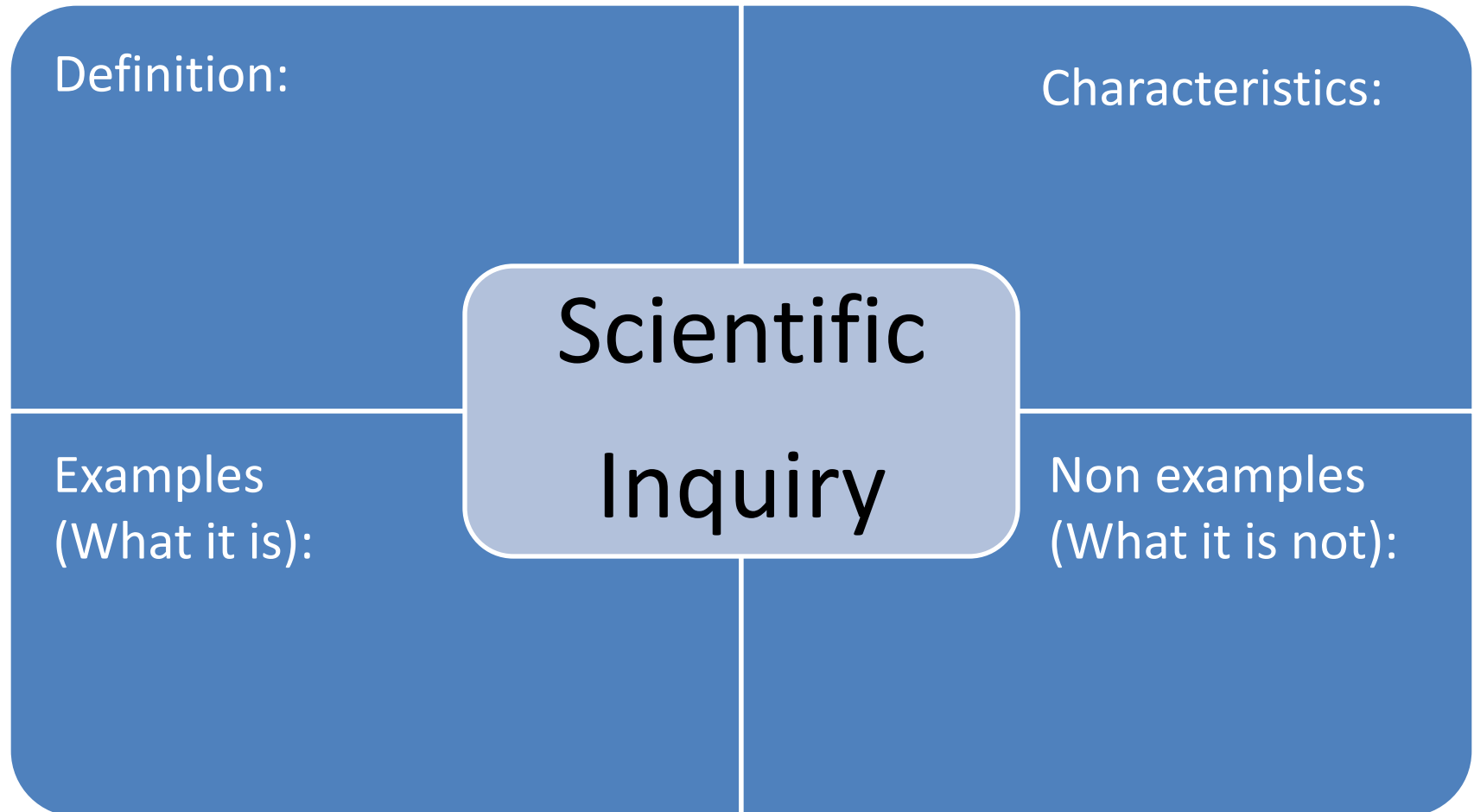




# What is Inquiry?



## The Frayer Model Revisited



# Definitions of Inquiry

- Inquiry involves making observations; posing questions; examining books and other sources of information to see what is already known in light of experimental evidence; using tools to gather, analyze and interpret data; proposing answers, explanations, and predictions; and communicating the results. Inquiry requires identification of assumptions, use of critical and logical thinking, and consideration of alternative explanations.
- Inquiry is the scientific process of active exploration by which we use critical, logical, and creative thinking skills to raise and engage in questions of personal interest. Driven by students' curiosity and wonder about observed phenomena, inquiry investigations usually involve:
  - Generating a question or problem to be solved
  - Brainstorming possible solutions to the problem
  - Stating a hypothesis to test
  - Choosing a course of action and carrying out the procedures of the investigation
  - Gathering and recording the data through observation and instrumentation to draw appropriate conclusions
  - Communicating findings

– National Research Council

– Llewellyn, pg. 24  
– Llewellyn, Inquiry Within pg. 16



# Closing Reflection

Imagine if we taught hockey the way we teach science...

Children would:

- read about hockey techniques
- hear stories about hockey greats, and hockey sweaters
- watch the teacher/coach demonstrate how to play, and
- write paper & pencil tests to see if they know how to play

As undergraduates they might be allowed:

- Under strict supervision, to reproduce famous historic hockey plays

**But only in graduate school would they, at last, actually get to play a game!**

